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By-Aitchison, Ian A.

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Cost control techniques as applied to university and college capital expenditure programs are discussed, as is the need for control of costs as an integral part of the design and construction of campus projects. The following phases of the cost control process are presented: pre-design advice and cost studies, preparation of the budget for the project, cost planning, control documentation, and cost control during construction. Audience reactions to the presentation are included. (FS)

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THE NEED FOR FULL COST CONTROL IN UNIVERSITIES AND COLLEGES CAPITAL EXPENDITURE PROGRAMMES.

By Ian A. Aitchison, A.R.I.C.S., A.I.arb

COMPREHENSIVE INTRODUCTION

"When we mean to build,
We first survey the plot, then draw the model;
And when we see the figure of the house;
Then we must rate the cost of the erection;
Which if we find outweighs ability,
What do we then, but draw anew the model;
In fewer offices; or at least,
Desist to build at all."

It is many years since these words from William Shakespeare's Henry IV were first spoken but the situation described has not changed and in fact has become more prevalent as construction costs continue to rise at an unprecedented rate, and buildings become larger, more complex and consequently more expensive.

There is, therefore, a great need today, for control of these costs during the design, and also during the construction, of a project.

This need is even greater in the case of educational projects such as university buildings, as these are built mainly with public money, and there is usually a very tight budget to work to. Also, how this budget is spent, is subject to a great deal of close scrutiny by many eyes, the most critical often being the "taxpayer".

The architect on a university project has therefore a deep responsibility to see that the budget set by the university is adhered to, and that the project is built within this cost forecast.

These, among other factors, have made the architect study the economy of his design with greater care and in more detail, and since the ultimate economy of a building is decided during the design stage, the architect has turned his attention to cost control procedures, and on many projects the client or the architect have invited the assistance of a professional quantity surveyor or cost consultant.

Through these procedures, the control of construction costs can now be made into a major creative factor in the design of good buildings.

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This is to say that keeping a project within its budget is only one aspect of cost control; there is another important aspect, namely, to ensure that the money available is spent in the best possible way.

Construction costs are therefore not just estimated afther the fact, when the architect has completed drawings at various stages, but controlled in a continuous manner in much the same way as materials, structure or services are controlled.

Cost control is then more than just a bookkeeping function and becomes an integral part of the architectural process intendes to produce good buildings.

In this way knowledge of costs as they develop and the actions taken to relate the costs to other architectural actions can be brought to bear on the complete problem in a manner that contribute meaning-fully to the whole architectural process.

To be effective, cost control must be a specialised function, and start at the very conception of a project, even before any drawings are prepared, and must continue throughout the whole development of a project to its ultimate completion.

In the early stages, estimates of cost must be made without drawings, or other means of determining what the building will be; these estimates will be based on assumptions, upon past experience, and upon creative visualization of the direction in which the design is likely to go.

These early estimates will be very approximate but as the work goes on, techniques for estimating and the estimates themselves will be refined more and more to reflect decisions made along the way, until the stage is reached just before bidding when these estimates will have been refined to a high degree of accuracy.

Cost control must then continue throughout the construction phase in order to ensure that changes, additions, and the like do not get out of hand and cancel out the good work done in the preceding phases.

Cost control ends only with the completion of the building, maybe not even then, since much of what has been done before that time will determine later maintenance and operating costs.

PRE-DESIGN COST ADVICE

To go into more detail, the first phase of the cost control process involves pre-design advice and cost studies, and begins after the architect has discussed the brief with the client. At this stage,

some indication will probably be required of the anticipated expenditure, and therefore the cost consultant may be asked to give general information on known costs of similar buildings with reasons for differences in cost according to amenities provided. By this means the broad feasibility of the project can be checked from a cost point of view.

To some extent the design of the building will be governed by such factors as planning and by-law requirements, fire regulations, and site conditions, and with these in mind the architect would now consider the basic form of the building. Cost information will be needed if it is necessary to compare the relative economies of alternative building shapes, heights, structural forms and maintenance consideration.

As soon as these problems have been tentatively resolved, it is useful to make a quick estimate of the likely cost of the building to ensure that this is broadly in line with anticipated expenditure. Shape, number of storeys and structural form have a very considerable bearing on cost and these can now be taken into account. The drawings at this stage will be to a small scale and of a preliminary nature. Depending on the amount of information and time available, the square foot method, cube foot, or possibly approximate quantities may be used. Only the main feature of the scheme will have been considered, so assumptions will have to be made regarding finishings, fittings and services, and provisional allowances made for these items.

General advice can also be given at this stage as to the effect on cost of prefabrication, standardisation, modular co-ordination, design economies and site conditions.

This cost advice enables design decisions to be made with full knowledge of their financial implications to the client. Early information of this nature often enables the client to make other financial decisions which he would otherwise have to delay.

At the beginning of this stage the client may, alternatively, set a rigid cost limit, usually because he has considerable first hand experience of similar buildings erected previously, and therefore knows approximately what the project should cost.

This would be very much the position in the case of a university which has a highly organised planning department that would not only prepare the budget but also the brief for the architect. The approach in this case would differ to the extent that the accomodation requirements must be checked against the cost limit to confirm that the project is feasible. This must be done by comparison with the known costs of similar buildings. The cost records in the form of detailed analyses, of past similar jobs may also provide a useful guide to the forms of construction which are likely to satisfy the cost requirements.

BUDGET ESTIMATE

The next phase of the cost control process involves the preparation of the budget for the project, if the client has not already set one.

During this stage the architect will develop his outline proposals into a basic design by further investigation of construction, and some consideration of services and finishes. The cost consultant can assist in this process with comparative costs for alternative forms of construction and mechanical and electrical installations. The drawings now will probably be more advanced, and include preliminary studies of construction and services. From these drawings a budget estimate for the project would be established. This would not be a "cover" figure, but a realistic assessment of the cost of the project based on an analysis of the known requirements combined with extensive historical date and specialist skill.

Such an estimate would be based on approximate quantities measured either in an omnibus fashion, for example, the external walls including internal and external finishes, etc., or separately in more detail, and priced at current rates. This estimate would also take into account the many factors that affect cost such as location and nature of site, use of industrialised components and methods, and likely market conditions at time of tendering.

Alternatively, this preliminary estimate can be based on an elemental analysis of a similar building, without involving the same degree of quantity measurement and pricing. For example, if the analysis showed the external wall element of the similar building as being $2.00 per square foot of floor area, this rate could be applied to the floor area of the building under consideration, and the whole estimate worked up in this manner. However, it is not as simple as this, and considerable experience and skill is required in the manipulation of these figures to arrive at a realistic estimate.

The sketch scheme and estimate can now be presented to the client for his approval. If approval is received the architect's task is now to carry out the detailed design within the estimate. If approval is not received, revisions to the scheme and estimate will first be necessary.

The independent cost consultant has a distinct advantage in preparing this estimate, as his cost library holds a more comprehensive range of analysed cost data, which has been built up over the years, from working with a variety of clients and architects on many projects.

COST PLANNING

The next phase of the cost control process is the most important one, as it is intended to ensure that the resulting scheme gives full value for money and is within the agreed cost limit.

It is only natural, every client wishes to know that he is getting value for money. Value for money not only in respect of capital cost but also in respect of maintenance and operating costs. This is appreciated by the cost consultant who has evolved a technique known as "cost planning" which enables his cost advice to be used objectively during the design process on every aspect of the structure.

Before this more effective form of cost control was introduced, the convential approach was to prepare a preliminary estimate when the initial design sketches were complete, and then one or two more detailed estimates prior to completion of working drawings. This could be termed "passive" estimating after the fact, and not likely to often produce good results as very little information is available at the time of the first estimate, and by the time the later detailed estimates are prepared, many important decisions have been made, and changes to the preliminary design carried out. It is therefore no wonder that there is sometimes a great difference between these estimates. If the final estimate is over the budget it is too late to change the drawings without involving delay and extra expense.

In contrast, cost planning takes place continuously throughout the detailed investigation into the constructional design of a project, prior to the preparation of the final working drawings. During this stage cost can be greatly influenced by the choice of materials and constructional details, for example, anodised aluminium windows or painted steel; brick or metal cladding. The preliminary cost investigations in the preceding phases now need to be backed up by using the estimate as a budget of expenditure, or "framework of costs", by reference to which materials can be chosen, and early thoughts on construction crystallised, so that overall cost is controlled and the money available distributed in a balanced manner.

This can be done by preparing a cost plan which consists of the various parts or elements of the building, such as roof, walls and floors, listed in a tabular form, with an outline specification and a provisional cost target or allowance set against each element. These targets can be taken from the detailed budget estimate if one has been prepared or from an analysis of a similar building adjusted to suit this particular building. These targets are subject to any redistribution of cost that the architect may feel desirable. They must provide for the required quantity of each element and the necessary standard of quality and finish.

In the case of some items, for example, structural frame, the exact form of construction may already have been decided. Some items such as roof coverings may have been settled previously but could possibly be altered without materially affecting the scheme.

It might be decided that a more desirable form of roof covering should be provided if the extra cost could be met by reducing the allowance for a less important item. Conversely if it were decided to spend more on finishings, a cheaper form of roof covering might be used to balance the total cost providing any increase in maintenance cost was acceptable to the client.

Details of other items such as external cladding panels, or internal partitions, may not have been settled at all at preliminary design stage, a cash allowance having been made for them in the estimate without knowledge of the form of construction that would eventually be employed. The various alternatives can now be considered; some may cost less than the allowances made, others more. Selection can be made, care being taken to ensure that if additional money is expended on one item, a compensating adjustment is made to another so that the overall cost of the scheme is not affected.

As the drafts for the parts of the buildings are produced, the cost of each can be checked against the cost plan, and any necessary adjustment made to the design or to the distribution of costs. When all designing is complete a final overall cost check can be made.

This part of the cost control process would be carried out by the cost consultant working closely with the designers and virtually "looking over the draftsmen's shoulders".

During this period account would be taken of such matters as escalation in labour and material costs and a constant eye kept on market conditions.

The use of a cost plan does not imply that the cheapest material should be selected in all cases, unless of course the client has specifically requested that this should be done. Rather its function is to enable the money available to be allocated in the best possible way.

To many architects cost planning may appear to be rather a harsh and anti-architectural discipline, but it is a self discipline, for the architect is party to the approximate estimate and is entirely responsible for the decisions made during the cost planning process.

Whilst acting as a discipline, the cost plan also grants more freedom, for the architect knows how much he can afford to spend on each part of the building, and he can more readily decide which technique, material, or finish he can incorporate into his design without fear of landing himself in cost difficulties when the tenders comes in.

The final operation is to produce full working drawings from the drafts. Once the detailed design is complete, the cost plan will have served its purpose, and although the distribution of money between the various parts of the building may have been revised from the original proposal, the overall estimated cost should be unaffected.

The results of this extensive cost planning process is a well designed building, giving full value for money within the agreed cost limit which is closely related to the accepted tender. The scheme can then proceed without delay, and the expense avoided in the re-design of the scheme to bring the tender back within the budget, if the cost limit had been exceeded.

CONTRACT DOCUMENTATION

It is essential in major phased programme such as the development of a university campus to establish and maintain a critical path programme covering both design and construction. In order to obtain the maximum benefit from such analyses they must be integrated with the system of cost control established for each project within the development.

Building works may be carried out under various contractual conditions and choice of the appropriate form of contract for any given project will depend upon the nature of the project, the circumstances under which it is being carried out, and the particular needs of the client.

On the whole, it is advantageous to use standard forms of contract which are recognized throughout the industry and have been drafted in the light of experience, as this ensures the rights and obligations of the parties to the contract and the duties of the professional advisors are clearly defined. By reason of his wide experience the cost consultant in conjunction with the architect, can advise on the right form of contract to be used. Changing conditions in recent years have brought into use many different types of contract. They vary particularly in the degree of risk borne by one party against the other, in the amount of contractor incentive involved and in the flexibility of use, for example, lump sum contracts provide minimum control and flexibility, and maximum incentive; target cost or fee contracts provide minimum control, maximum flexibility, moderate incentive; quantity survey contracts provide maximum control, maximum flexibility, maximum incentive. The importance of selecting the right type of contract for the project is paramount. Upon it depends the success or otherwise of the financial control of the work.

COST CONTROL DURING CONSTRUCTION

The successful financial outcome of a project depends upon the effectiveness of the cost control process throughout the construction period.

Effective cost control can only be achieved by the use of the most advanced quantity surveying techniques embodying cost planning, design/cost liason and specialist advice, regular cost reporting and proper contract documentation.

During construction, changes in the work are frequently necessary sometimes to take account of the changing needs of the client, and sometimes to overcome site conditions. On difficult projects, the cost consultant can value these changes and report their affect on the probable final cost so that corrective steps can be taken elsewhere in the work if the client wishes to keep the overall cost down to that which he has authorised.

Where a cost plan has been prepared in the design stage, the cost consultant can review this plan in the light of the accepted tender, and it can then be used as a basis for cost control during construction. As part of this systematic control of cost during the progress of the work the cost consultant can prepare at regular intervals financial statements which keep the client and the architect fully informed of the up-to-date financial position, and anticipated final cost of the work.

At the completion of this phase, a detailed analysis of the cost of the project should be prepare for record purposes and quidance on future schemes.

CONCLUSION

It should also be noted here that the cost control techniques described in this paper can be equally applied to small projects as well as to large ones; and particularly to jobs which involve alterations or additions to an existing building as the cost implications of such work are usually more difficult to assess, and the finances more difficult to control than they are for a new building.

As you can now appreciate, the broadest possible approach is required for effective cost control, as cost is not only affected by the size, shape and quality of a building, but by the location of the buildings, the site conditions, the time allowed for design and construction, type of contract, market conditions, financing and many other factors.

To be successful this specialised process of cost control requires the talents of trained quantity surveyors who understand the whole architectural and construction process, and who can approach their work in a creative manner.

These cost consultants will have a deep knowledge of construction costs and methods, and have access to an extensive library of private and published cost and other relevant data.

The training of these construction economists needs to be an extensive one, and cover such subjects as contract procedures, law and arbitrations, economics and finance as well as the technical subjects of the construction industry.

Today a great deal is said and written about construction costs but little practical action has been taken to introduce an effective instrument of cost control into the construction industry.

The handling of such construction costs in most architectural offices is rudimentary when compared with methods used in say, the manufacturing industries. It is common practice in such industries for highly paid imaginative and talented people to be deeply involved in the cost structure of the product produced. Among successful manufacturing companies it would be difficult to find a case in which budgetary estimating, cost projections, record keeping and analysis of costs is not highly developed, considered of utmost importance, and handled in a manner consistent with their importance.

For the mostpart this is not true in architecture, but it could be by making full use of the cost control procedures described in this paper.

The results of exercising such control can be better design buildings that come within their budget, more efficient professional services, and therefore more satisfied clients.

MR. PHILLIPS: We cannot spend too long on questions but we do have enough time for one or two.

MR. STOTT, YORK UNIVERSITY: Can you tell us how this service is normally arranged as far as a fee is concerned. Is it on a percentage of the cost or a fee basis?

MR. AITCHISON: It can be done any way, on the agreement of a lump sum for services, or a percentage basis, or a per diem rate basis.

MR. STOTT, YORK UNIVERSITY: Does this service start prior to the appointment of the architect.

MR. AITCHISON: It should start at the same time the architect is appointed, but on some occasions we have been called in before the architect has been appointed.

QUESTION: Generally speaking, what is the fee for this service?

MR. AITCHISON: If the fee is on a percentage basis, it would be one-quarter to one-half of one percent.

QUESTION: Would you make any more comments about the quantity survey type of contract and does this involve your service more or less than the other type of contracts?

MR. AITCHISON: This system is the normal one in Great Britain and in many other countries in the world, like Switzerland, Germany. In North America it is not generally used and in some respect it is a fairly controversial subject.

I sincerely believe that the time is ripe and we should try and introduce some better form of contract documentation involving some type of quantity survey document. The present system is very inefficient and wasteful, and you are paying too much for your buildings. Whether it will ever be introduced depends on some far-seeing clients doing something about it. It also requires the co-operation of the construction industry.

QUESTION: What is a reasonable percentage of agreement to expect between the actual estimate and the contract as it comes out.

MR. AITCHISON: We try to get it exactly the same, but we think it is good if we are within 5% of that figure, and we have in many cases been less than that. But the important point here is that I do not feel you can expect your cost consultant to do this unless you will let him provide the continued service; the one estimate at the begining and the end does not produce results.

QUESTION: Can you comment on contract acceptance? I understand a few years back that it was the procedure for the contractors to bid on an itemized list. Is there any change in this?

MR. AITCHISON: You are right on this point. The position has not changed but there are one or two people in the government circles who think it is time for a change.

MR. WHENHAM: Now it is time for us to get under way. I would like to say we are very pleased with Mr. Aitchison's presentation. It was very interesting and I think we all appreciated it very much. If there are any further questions, Mr. Aitchison will be available and some of his associates are here and they will be willing to answer any questions.